

Occurrence and recurrence of gastric dilatation with or without volvulus after incisional gastropexy

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Abstract — This study investigated recurrence of gastric dilatation without (GD) or with volvulus (GDV) after incisional gastropexy (IG) in dogs that underwent IG for prevention of GDV. Signalment, concurrent surgical procedures, presence of GD or GDV at the time of IG were obtained from medical records of dogs that underwent IG. Owners were contacted to determine whether the dogs experienced GD or GDV after IG, dates of postoperative GD or GDV episodes, survival status, date of death for deceased dogs. Gastric dilatation and GDV recurrence rates were calculated for 40 dogs that had at least 2 y follow-up from the time when IG was performed and for dogs that experienced GD or GDV during the follow-up period. No dogs experienced GDV after IG and 2 dogs (5.0%) experienced GD after IG. The results suggest that GD and GDV rates after IG may be comparable to recurrence rates after other methods of gastropexy.

Résumé — **Occurrence et récurrence de la dilatation gastrique avec ou sans volvulus après une gastropexie incisionnelle.** Cette étude a examiné la récurrence de la dilatation gastrique sans volvulus (DG) ou avec volvulus (DGV) après une gastropexie incisionnelle (GI) chez les chiens qui avaient subi une GI pour la prévention de la DGV. Le signalement, les interventions chirurgicales concomitantes, la présence de la DG ou de la DGV au moment de la GI ont été obtenus dans les dossiers médicaux de chiens qui ont subi une GI. On a contacté les propriétaires pour déterminer si les chiens avaient eu une DG ou une DGV après la GI, les dates des épisodes postopératoires de DG ou de DGV, l'état de la survie et la date de la mort pour les chiens décédés. Les taux de récurrence de la dilatation gastrique et de la DGV ont été calculés pour 40 chiens qui ont eu un suivi d'au moins 2 ans à partir de la réalisation de la GI et pour les chiens qui avaient eu une DG ou une DGV durant la période de suivi. Aucun chien n'a eu une DGV après une GI et 2 chiens (5,0 %) ont connu une DG après la GI. Les résultats suggèrent que les taux de DG et de DGV peuvent être comparables aux taux de récurrence après d'autres méthodes de gastropexie.

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Introduction

Gastric dilatation with or without volvulus is a life-threatening condition. Early studies showed mortality rates between 33% and 68% for dogs with GDV (1–4). Recent studies reported mortality rates between 10% and 26.8% (3–8).

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The use of gastropexy has been associated with decreased GDV recurrence and improved survival (9–10). Median survival times in dogs that experienced GDV and were treated without gastropexy is 188 d compared to 547 d for dogs treated with gastropexy at the time of GDV (10). One year GDV-related mortality rate for dogs with circumcostal gastropexy is 19% compared with 71% for dogs without gastropexy (9). Recurrence of GDV in dogs without gastropexy has been reported as high as 50% (9).

With improved mortality rates and decreased recurrence rates seen with the use of gastropexy, various methods of gastropexy have been developed. Open approach methods of gastropexy include: circumcostal (11), gastrocolopexy (12), incisional (13), belt-loop (14), incorporating (15), and tube gastropexy (16). Minimally invasive gastropexy techniques include: grid approach (17), laparoscopic (18–20), laparoscopic-assisted (19–25), and endoscopically assisted (26,27). Additionally, the method of fixation differs depending on type of suture or stapling equipment that is used for the gastropexy.

Despite the proven success of gastropexy, few studies have compared recurrence rates for different techniques. The aim

of our study was to report GD and GDV recurrence rates after incisional gastropexy.

Materials and methods

Case selection

As part of an ongoing study on incisional gastropexy, medical records at a single referral center were reviewed for all dogs that underwent incisional gastropexy between 2004 and 2012. Data collected from the records included: signalment; weight of the patient; age of the patient at the time of incisional gastropexy; occurrence of GD or GDV prior to incisional gastropexy; concurrent surgical procedures such as splenectomy, gastrectomy, or stomach invagination that were performed at the time of incisional gastropexy; and the type and size of suture used to perform the gastropexy. Dogs with incomplete medical records and dogs that underwent left-sided incisional gastropexy for treatment of hiatal hernias were excluded from the study.

Incisional gastropexy

All surgeries were completed by 1 of 2 board-certified surgeons. Briefly, a 4- to 5-cm seromuscular incision was created in the pyloric antrum parallel to the long axis of the stomach. An incision was then created in the right lateral abdominal wall through the peritoneum and the transverse abdominus muscle approximately 2 cm caudal to the last rib. The seromuscular layer of the stomach was then sutured to the transverse abdominus muscle in 2 simple continuous patterns with a suture type and size determined by the surgeon.

Follow-up

All owners of dogs that did not die or were not euthanized during the post-gastropexy hospitalization period were contacted via telephone to be asked the following: if the dog experienced GD or GDV after gastropexy; if the patient was currently alive; for the deceased dogs, what the cause of death was and when the death occurred. If the owner could not be contacted, the dog was excluded from the study.

Data analysis

SPSS for Windows, Version 17 (IBM, Armonk, New York, USA) was used for data management and statistical analysis. Descriptive statistics (means, standard deviations, medians, ranges, frequencies, and percentages) were calculated. Means are presented \pm standard deviation. The log-rank test with a 0.05 significance level was used to compare dogs with GDV at the time of gastropexy, dogs with GD at the time of gastropexy, and dogs without GDV or GD at the time of gastropexy with respect to survival. To calculate the GD and GDV rates after gastropexy, only the dogs with at least 2 y of follow-up or that experienced GD or GDV after surgery were used.

Results

Eighty-two dogs out of 167 cases met the criteria for inclusion in the study; 57 were males (54 neutered, 3 intact) and 25 were females (all spayed). Breeds included German shepherd ($n = 14$), great Dane ($n = 9$), golden retriever ($n = 7$), boxer ($n = 5$), doberman pinscher ($n = 5$), mixed breed ($n = 5$), Weimaraner

($n = 5$), Labrador retriever ($n = 4$), standard poodle ($n = 4$), mastiff ($n = 3$), akita ($n = 2$), Alaskan malamute ($n = 2$), chow chow ($n = 2$), rottweiler ($n = 2$), Samoyed ($n = 2$), Siberian husky ($n = 2$), and 1 each of basset hound, bloodhound, English spaniel, Gordon setter, Irish setter, Irish wolfhound, Newfoundland, shar pei, and saint bernard. At the time of gastropexy, the mean age was $6.5 \text{ y} \pm 3.4 \text{ y}$ (median: 7.0 y; range: 0.3 to 15.0 y) and the mean body weight was $36.4 \text{ kg} \pm 13.8 \text{ kg}$ (median: 33.9 kg; range: 7.9 to 80.2 kg). Three dogs had prior splenectomy, and 1 dog had a prior GD episode.

Gastropexy was performed in 64 dogs with GDV at the time of gastropexy, 3 dogs with GD at the time of gastropexy, and 15 dogs without GDV or GD at the time of surgery. For dogs without GD or GDV at the time of surgery, gastropexy was performed concurrently with enterotomy ($n = 4$), splenectomy ($n = 3$), gastric and intestinal biopsies ($n = 2$), ovariohysterectomy ($n = 2$), splenectomy, gastrotomy, and liver biopsy ($n = 1$), gastrotomy ($n = 1$), or enterotomy and gastrotomy ($n = 1$). Only 1 dog with GD at the time of gastropexy had concurrent surgery, which consisted of gastric and intestinal biopsies. For dogs with GDV at the time of gastropexy, the concurrent surgeries included partial gastrectomy ($n = 5$), stomach invagination and splenectomy ($n = 3$), stomach invagination ($n = 2$), partial gastrectomy and splenectomy ($n = 1$), splenectomy ($n = 1$), adrenalectomy ($n = 1$), and gastric and intestinal biopsies (1). The suture types used for the gastropexy were polydioxanone (PDS; Ethicon, Somerville, New Jersey, USA) size 0 ($n = 45$), 1 ($n = 15$), 2–0 ($n = 18$) and polypropylene (Prolene, Ethicon) size 0 ($n = 3$) and 1 ($n = 1$).

Five dogs died before discharge after gastropexy, 4 with GDV at the time of surgery and 1 without GDV or GD at the time of gastropexy. Forty-three dogs died during the follow-up period: 38 (59.4%) of the dogs with GDV at the time of gastropexy, 2 (66.7%) of the dogs with GD at the time of gastropexy, and 3 (20.0%) of the dogs without GDV or GD at the time of gastropexy. There was no statistically significant difference between these groups of dogs with respect to survival ($P = 0.31$). For the 39 dogs that were still alive at last follow-up, the mean follow-up time for investigating survival was $2.3 \pm 2.2 \text{ y}$ (median: 1.8 y; range: 7 d to 8.8 y).

Forty dogs in this study had at least 2 y of GD and GDV follow-up or had experienced GD after incisional gastropexy. None of the dogs experienced GDV during the follow-up period, and 2 of these 40 dogs (5.0%) experienced GD. One of the 2 dogs that experienced GD after incisional gastropexy was a 9-year-old male boxer dog that was presented with GDV at the time the gastropexy was performed. This dog was taken to the same clinic where the gastropexy was performed 1 mo after the incisional gastropexy and was diagnosed and treated for GD. The dog had several additional bouts of GD and underwent an exploratory celiotomy at another referral clinic where they repositioned the incisional gastropexy. The dog continued to have recurrence of GD following the revised gastropexy and was still alive 6 mo after the original gastropexy surgery. The second dog to experience GD after incisional gastropexy was a 6-year-old female golden retriever dog that did not have GDV or GD at the time of gastropexy; however, the dog did experience GD

prior to incisional gastropexy. This dog experienced GD 3 mo after gastropexy and was treated at another clinic. This dog was still alive 10 mo after surgery.

For dogs that did not experience GDV or GD after incisional gastropexy and had at least 2 years of follow-up, the mean follow-up time was $4.1 \text{ y} \pm 1.7 \text{ y}$ (median: 4.0 y; range: 2.0 to 8.8 y) for all of these dogs and $3.9 \text{ y} \pm 1.5 \text{ y}$ (median: 3.9 y; range: 2.0 to 8.3 y) for the dogs with GDV at the time of gastropexy. Because none of the dogs experienced GDV after the gastropexy and only 2 dogs experienced GD after gastropexy, it was not possible to investigate risk factors for post-gastropexy GDV or GD.

Discussion

Although gastropexy reduces recurrence rates of GDV (9,10), it is possible that specific methods of gastropexy are superior in preventing recurrence. Several studies have investigated GD and GDV recurrence rates of specific methods of gastropexy (9,10,12,14,28–33). Fewer papers have a long-term follow-up of a large sample of dogs with a specific type of gastropexy and evaluated them for GD and GDV recurrence (9,12,15,31,32). If recurrence rates differ for some of the methods of gastropexy, this would be a factor for the surgeon to take into consideration when deciding which type of gastropexy to perform.

Prophylactic laparoscopic-assisted gastropexy was studied in 23 dogs and showed no occurrence of GDV in any of the dogs within a year of the gastropexy (24). Prophylactic endoscopic-assisted gastropexy in 24 dogs showed no occurrence of GDV throughout their follow-up period (26). However, because gastropexy was performed prophylactically in both of those studies, it is possible that none of the dogs would ever develop GDV even without gastropexy.

The recurrence rate of GDV after circumcostal gastropexy is as high as 9% (range: 3.3% to 9%) (12,28–29). One study found no recurrence of GDV after circumcostal gastropexy, but the sample size was only 5 dogs (30). Another study found recurrence rates of GDV within 12 mo to be 9% for circumcostal gastropexy and 10% for dogs with gastrocolopexy (12). When all cases in that study had a minimum follow-up time of 400 d, the recurrence rate for circumcostal gastropexy remained unchanged but increased to 20% for gastrocolopexy. Seven years after the study, the authors reported in a letter to the editor that no additional dogs had recurrence since the conclusion of that study (31).

A study of dogs with GDV that were treated with a muscular flap gastropexy and a Fredet-Ramstedt pyloromyotomy found no recurrence of GDV during 3 to 33 mo of follow-up (32). A study on belt-loop gastropexy also reported no GDV recurrences after gastropexy during 3 to 13 mo of follow-up; however, 1 dog needed gastric decompression immediately after it left the hospital (14).

Another study found no evidence of GDV recurrence in 16 dogs that underwent incisional gastropexy (33). Although the results of that study showed no recurrence, there was a small sample size and half of the subjects were evaluated for a maximum time of 67 d. No recurrence of GDV after incisional gastropexy was reported in a previous study; however, the aim

of that study was to describe the gastropexy technique and show that the gastropexy fixation was present 6 mo after the surgery (13). The authors of that study simply mention that they had been using that gastropexy technique in client-owned dogs and had no recurrence of GDV. There was a report of GDV recurrence in a dog after an incisional gastropexy (34). In the present study, none of the 64 dogs with GDV at the time of gastropexy experienced recurrence of GDV and 1 experienced GD after gastropexy. It is possible that with longer follow-up time, additional dogs may develop GD or GDV.

There are conflicting reports as to whether splenectomy may predispose a dog to GDV (35–37). With our cases, we looked at whether the patient had a splenectomy prior to gastropexy, at the time of gastropexy, or not at all. Three of the 64 dogs (4.7%) with GDV at the time of gastropexy had a previous splenectomy. Since there were no cases of GDV after gastropexy, we could not determine if splenectomy was a risk factor for recurrence.

Some surgeons base their selection of a gastropexy method on laboratory determined gastropexy strength measurements (18,22,30,38). However, it is not known what force the gastropexy is subjected to *in vivo*. Clinical recurrence rates appear to be a better basis for choosing a gastropexy method.

Several limitations of the present study are due to its retrospective nature. First, although owners of dogs that have GD or GDV should be aware of the clinical signs associated with GD or GDV, some of the owners may not have recognized clinical signs of GD after gastropexy if the signs were mild or if the owner was not present to witness them. However, Eggertsdóttir et al (31) maintained that owners of dogs who experienced GDV are able to recognize clinical signs associated with abdominal signs (31) and owners who had a prophylactic gastropexy performed on their dog must have some understanding of GD and GDV. Additionally, owners of dogs that had undergone gastropexy at our clinic were educated on clinical signs of GD and GDV upon discharge.

Another possibility is that some owners may have failed to recall a GD or GDV episode after gastropexy. Since GDV and GD can be life-threatening, it seems less likely that an owner would not recall if it occurred. During the telephone interview with owners, the authors questioned owners in detail about signs of GDV and GD. If owners reported that the dog had been euthanized, the authors asked for a specific reason for the euthanasia. If the dogs had died, the owners were asked if the cause of death was known or if a necropsy was performed.

Some of the dogs that were lost to follow-up or were excluded from the study for having an incomplete record may have experienced GD or GDV after gastropexy which would have increased the numbers of occurrence/recurrence. As a result, the GD and GDV rates after incisional gastropexy may be higher than our results suggest. This should be taken into account when interpreting the results of the present study. It is important to note that despite having an incisional gastropexy, GDV may still occur as was discussed in a case report about a rottweiler dog that had GDV recurrence after receiving an incisional gastropexy (34).

Gastric dilatation and GDV can occur many years after gastropexy as an increase in age has been reported to be a risk

factor for GDV (39). A study of 166 dogs with GDV reported a mean age of $7.3 \text{ y} \pm 3.5 \text{ y}$ (range: 0.3 to 16.5 y) at the time of examination (8). Therefore, follow-up should be as long as possible, especially for dogs with elective gastropexies, which are often performed in very young dogs. This may be the reason why none of the dogs that did not have GD or GDV at or before gastropexy experienced GD or GDV during the follow-up period. Although both dogs in the present study that experienced GD after incisional gastropexy did so within 3 mo of surgery, additional dogs may experience GD or GDV over time. We will continue to follow-up on the study dogs to determine whether recurrence rates increase as the time since gastropexy increases.

Although additional research is needed, the results of this study suggest that GD and GDV rates after incisional gastropexy may be comparable to recurrence rates for other methods of gastropexy.

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References

- Muir WM. Gastric dilatation-volvulus in the dog, with emphasis on cardiac arrhythmias. *J Am Vet Med Assoc* 1982;180:739–742.
- Pass M, Johnston D. Treatment of gastric dilatation and torsion in the dog. Gastric decompression by gastrotomy under local analgesia. *J Small Anim Pract* 1973;14:131–142.
- Mackenzie G, Barnhart M, Kennedy S, Dehoff W, Schertel E. A retrospective study of factors influencing survival following surgery for gastric dilatation-volvulus syndrome in 306 dogs. *J Am Anim Hosp Assoc* 2010;46:97–102.
- Israeli I, Steiner J, Segev G, et al. Serum pepsinogen-A, canine pancreatic lipase immunoreactivity and C-reactive protein as prognostic markers in dogs with gastric dilatation-volvulus. *J Vet Intern Med* 2012;26:920–928.
- Green TI, Tonozi CC, Kirby R, Rudloff E. Evaluation of initial plasma lactate values as a predictor of gastric necrosis and initial and subsequent plasma lactate values as a predictor of survival in dogs with gastric dilatation-volvulus: 84 dogs (2003–2007). *J Vet Emerg Crit Care* 2011;21:36–44.
- Adamik KN, Burgener IA, Kovacevic A, Schulze SP, Kohn B. Myoglobin as a prognostic indicator for the outcome in dogs with gastric dilatation-volvulus. *J Vet Emerg Crit Care* 2009;19:247–253.
- Buber T, Saragusty J, Ranen E, Epstein A, Bdolah-Abram T, Bruchim Y. Evaluation of lidocaine treatment and risk factors for death associated with gastric dilatation and volvulus in dogs: 112 cases (1997–2005). *J Am Vet Med Assoc* 2007;230:1334–1339.
- Beck JJ, Staats AJ, Pelsue DH, et al. Risk factors associated with short-term outcome and development of perioperative complications in dogs undergoing surgery because of gastric dilatation-volvulus: 166 cases (1992–2003). *J Am Vet Med Assoc* 2006;229:1934–1939.
- Eggertsdóttir AV, Stigen Ø, Lønaas L, Kolbjørnsen Ø, Moe L. Comparison of two surgical treatments of gastric dilatation-volvulus in dogs. *Acta Vet Scand* 1996;37:415–426.
- Glickman LT, Lantz GC, Schellenberg DB, Glickman NW. A prospective study of survival and recurrence following the acute gastric dilatation-volvulus syndrome in 136 dogs. *J Am Anim Hosp Assoc* 1998;34:253–259.
- Fallah AM, Lumb WM, Nelson AW, Frandson RD, Withrow SJ. Circumcostal gastropexy in the dog: A preliminary study. *Vet Surg* 1982;11:19–22.
- Eggertsdóttir AV, Stigen Ø, Lønaas L, et al. Comparison of the recurrence rate of gastric dilatation with or without volvulus in dogs after circumcostal gastropexy versus gastrocolopexy. *Vet Surg* 2001;30:546–551.
- MacCoy DM, Sykes GP, Hoffer RE, et al. A gastropexy technique for permanent fixation of the pyloric antrum. *J Am Anim Hosp Assoc* 1982;18:763–768.
- Whitney WO, Scavelli TD, Matthiesen DT, et al. Belt-loop gastropexy: Technique and surgical results in 20 dogs. *J Am Anim Hosp Assoc* 1989;25:75–83.
- Meyer-Lindenberg A, Harder A, Fehr M, Luerssen D, Brunnberg L. Treatment of gastric dilatation-volvulus and a rapid method for prevention of relapse in dogs: 134 cases (1988–1991). *J Am Vet Med Assoc* 1993;203:1303–1307.
- Parks J. Surgical management of gastric torsion. *Vet Clin North Am Small Anim Pract* 1979;9:259–267.
- Steelman-Szymczek SM, Stebbins ME, Hardie EM. Clinical evaluation of a right-sided prophylactic gastropexy via a grid approach. *J Am Anim Hosp Assoc* 2003;39:397–402.
- Hardie RJ, Flanders JA, Schmidt P, Credile KM, Pedrick TP, Short CE. Biomechanical and histological evaluation of a laparoscopic stapled gastropexy technique in dogs. *Vet Surg* 1996;25:127–133.
- Runge JJ, Mayhew P, Rawlings CA. Surgical views: Laparoscopic-assisted and laparoscopic prophylactic gastropexy: Indications and techniques. *Compend Contin Educ Vet* 2009;31:58–65.
- Mayhew PD, Brown DC. Prospective evaluation of two intracorporeally sutured prophylactic laparoscopic gastropexy techniques compared with laparoscopic-assisted gastropexy in dogs. *Vet Surg* 2009;38:738–746.
- Wilson ER, Henderson RA, Montgomery RD, Kincaid SA, Wright JC, Hanson RR. A comparison of laparoscopic and belt-loop gastropexy in dogs. *Vet Surg* 1996;25:221–227.
- Rawlings CA, Foutz TL, Mahaffey MB, Howerth EW, Bement S, Canalis C. A rapid and strong laparoscopic-assisted gastropexy in dogs. *Am J Vet Res* 2001;62:871–875.
- Rawlings CA. Laparoscopic-assisted gastropexy. *J Am Anim Hosp Assoc* 2002;38:15–19.
- Rawlings CA, Mahaffey MB, Bement S, Canalis C. Prospective evaluation of laparoscopic-assisted gastropexy in dogs susceptible to gastric dilatation. *J Am Vet Med Assoc* 2002;221:1576–1581.
- River P, Furneaux R, Viguier E. Combined laparoscopic ovariectomy and laparoscopic-assisted gastropexy in dogs susceptible to gastric dilatation-volvulus. *Can Vet J* 2011;52:62–66.
- Dujowich M, Reimer SB. Evaluation of an endoscopically assisted gastropexy technique in dogs. *Am J Vet Res* 2008;69:537–541.
- Dujowich M, Keller ME, Reimer SB. Evaluation of short- and long-term complications after endoscopically assisted gastropexy in dogs. *J Am Vet Med Assoc* 2010;236:177–182.
- Leib MS, Konde LJ, Wingfield WE, Twedt DC. Circumcostal gastropexy for preventing recurrence of gastric dilatation-volvulus in the dog: An evaluation of 30 cases. *J Am Vet Med Assoc* 1985;187:245–248.
- Woolfson JM, Kostolich M. Circumcostal gastropexy: Clinical use of the technique in 34 dogs with gastric dilatation-volvulus. *J Am Anim Hosp Assoc* 1986;22:825–830.
- Fox S, Ellison G, Miller G. Observations on the mechanical failure of three gastropexy techniques. *J Am Anim Hosp Assoc* 1985;21:729–734.
- Eggertsdóttir AV, Langeland M, Fuglem B. Long-term outcome in dogs after circumcostal gastropexy or gastrocolopexy for gastric dilatation with or without volvulus. Letter to the Editor. *Vet Surg* 2008;37:809–810.
- Schulman AJ, Lusk R, Lippincott CL, et al. Muscular flap gastropexy: A new surgical technique to prevent recurrences of gastric dilatation-volvulus syndrome. *J Am Anim Hosp Assoc* 1986;22:339–346.
- Wacker CA, Weber UT, Tanno F, Lang J. Ultrasonographic evaluation of adhesions induced by incisional gastropexy in 16 dogs. *J Sm Anim Pract* 1998;39:379–384.
- Hammel SP, Novo RE. Recurrence of gastric dilatation-volvulus after incisional gastropexy in a Rottweiler. *J Am Anim Hosp Assoc* 2006;42:147–150.
- Grange AM, Clough W, Casale SA. Evaluation of splenectomy as a risk factor for gastric dilatation-volvulus. *J Am Vet Med Assoc* 2012;241:461–466.
- Goldhammer MA, Haining H, Milne EM, Shaw DJ, Yool DA. Assessment of the incidence of GDV following splenectomy in dogs. *J Small Anim Pract* 2010;51:23–28.
- Millis DL, Nemzek J, Riggs C, Walshaw R. Gastric dilatation-volvulus after splenic torsion in two dogs. *J Am Vet Med Assoc* 1995;207:314–315.
- Waschak M. Evaluation of percutaneous gastrostomy as a technique for permanent gastropexy. *Vet Surg* 1997;26:235–241.
- Glickman LT, Glickman NW, Perez CM, Schellenberg DB, Lantz GC. Analysis of risk factors for gastric dilatation and dilatation-volvulus in dogs. *J Am Vet Med Assoc* 1994;204:1465–1471.